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ABSTRACT

The Measurement and Costing Model (MCM) described in this book was developed and tested at Fox Valley Technical College (FVTC), Wisconsin, to enhance the college's quality improvement process and to serve as a guide to other institutions interested in improving their quality. The book presents a description of the model and outlines seven steps other schools can use to implement the MCM. The seven steps are as follows: (1) determine the key elements of educational quality; (2) establish criteria or "conforming requirements" for measuring quality in each area; (3) decide on measurement strategies; (4) implement measurement techniques; (5) design a costing system; (6) calculate the costs of quality; and (7) set goals. Appendixes contain charts for each of six quality elements, including information on conforming requirements, measurement strategies, and the cost of nonconformance. The six quality elements are human resources, curriculum and instruction, planning, marketing, use of technology, and customer service. In addition, 1987-88 costs of conformance and nonconformance are detailed. (WJT)

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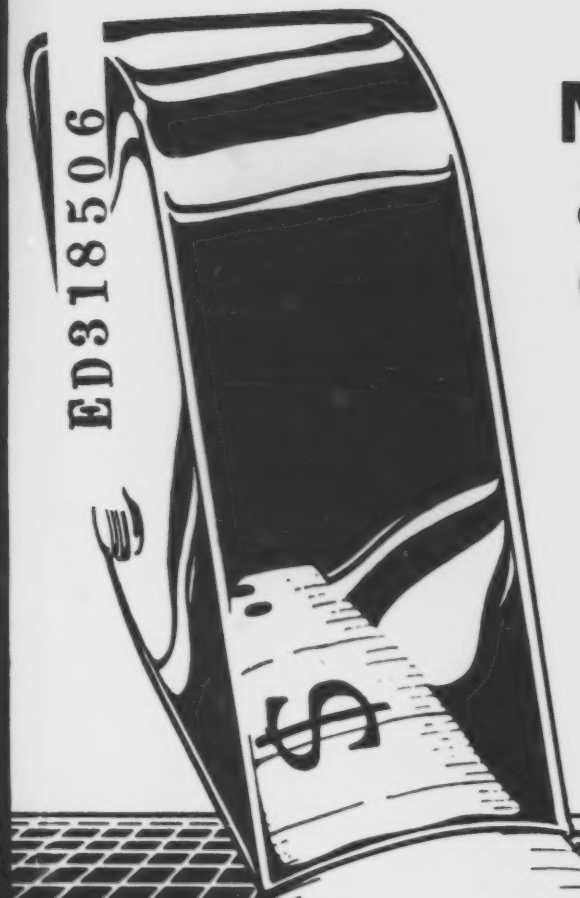

Measuring and Costing Quality in Education

Using Quality and Productivity Methods to Improve Schools

By Stanley J. Spanbauer, Ph.D.

In Cooperation with the Faculty and Staff of Fox Valley Technical College

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About the Author

Stanley J. Spanbauer has twenty-five years of experience in post-secondary technical college education. He was Director of Instruction at Fox Valley Technical College (FVTC), Appleton, Wisconsin, for sixteen years, and currently is completing his seventh year as Chief Executive Officer/President at the College. Under his leadership, FVTC has gained a national reputation for its innovations in instructional methodology, economic development, and computer-based education. The college currently enrolls over 45,000 full- and part-time students in a perpetual enrollment/graduation system.

He is past president and a charter member of the Board of Directors of the Midwest Association for Individualized Instruction.

Since 1985, he has led FVTC faculty and staff in the implementation of a quality first movement at the college--the first public college in the country to initiate a formal quality process in its service and instructional components. His first publication, Quality First in Education . . . Why Not? has received national and international attention. He was also a contributor for the publication, Fox Valley Technical College Quality First Process Model.

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Using Quality and Productivity Methods to Improve Schools

By Stanley J. Spanbauer, Ph.D.

In cooperation with the Faculty and Staff of the Fox Valley Technical College

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Photographic Services - Gary Kiehne

This publication was reviewed by three committees:

Quality Improvement Council

- Judy Arndt
- Don Beno
- Mary Brefeld
- Robert Darula
- Debby DeRosso
- Mike Flanagan
- Merlin Gentz
- Jeanne Joseph
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- Jack Clarke
- Merlin Gentz
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- Lori Weyers
- Jerry Wolf

Dedication

This book is dedicated . . .

To the faculty, staff, and students of Fox Valley Technical College. Their enthusiasm for and commitment to excellence is the impetus for innovation which has distinguished FVTC.

And to the Fox Valley Technical College Board. Their dedication and support has created the environment to foster continual growth.

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Foreword

Quality improvement continues to be a major strategic thrust at Fox Valley Technical College. As stated in our quality policy, we seek to provide instruction and services that consistently meet or exceed the expectations of our internal and external customers.

This requires our managers to clarify specific responsibilities for quality and to develop strategic plans and objectives related to quality on an ongoing basis. It demands that every person be a part of our quality system to identify and eliminate the sources of errors in our processes and procedures.

Part of the process of seeking continued improvement is to provide everyone in the educational setting with the tools and techniques of problem solving and measurement. This includes understanding the powerful tools of statistical thinking and statistical methods. Administrators in schools especially need these tools to effectively manage their operations and departments.

In addition, it is essential that educators seek to know the costs of poor quality and learn to measure and cost the performance of processes both before and after corrective actions have been taken.

The Measurement and Costing Model described in this manual has evolved following more than four years of experiences in designing and implementing the quality process at Fox Valley Technical College. Since the quest for quality is a perpetual process, this plan will continue to change as we strive for perfection.

Stanley J. Spanbauer, Ph.D.
Director/President

Introduction

- Can we describe, judge, and improve the effectiveness of schools?
- Can we correctly and concisely measure the variances found in the processes common to education?
- Can quality in education be looked at in financial terms the way it is in business and industry?
- Are statistical techniques and processes useful for measurement in education?

These important questions are being asked more and more as school critics demand reform in education. It is imperative that educators look for answers. For no matter how good our schools are or how good they have been, they must become better to meet the educational needs of our fast-changing, technological world. Today, our nation's economic plight is being placed squarely in the realm of education. Calls for school reform are more prevalent than ever before. Most of these calls for reform ask for a complete overhaul of the system, and they're coming from those outside the school--parents, citizens, and legislators, rather than from the educational establishment--teachers, administrators, and graduate school professors.[1]

No matter how good our schools are or how good they have been, they must become better to meet the educational needs of our fast-changing, technological world.

Somewhere between traditional school operation and radical reform lies the answer to improvement of our schools. The quality process provides the mechanism for the meaningful change which is required. While the change should be fostered by educators themselves rather than by those outside the schools, private sector techniques of management, measurement, and costing can be applied. However, there are no quick fixes in

educational reform. While it is possible to have a positive impact on improvement in a short time, no effort can substantially change school culture in less than three to five years.

The public is calling for new methods of accountability in education.

Schools, by their very nature, are continually involved in measurement, whether it be testing the success of students and/or competence of teachers and staff, or determining the success or need for improvement. However, some of these practices need renewal. Today, the public is calling for new methods of accountability in education, replacing archaic and outmoded practices which are unacceptable. Since education is critical to our nation's future, we can no longer maintain the status quo. We must turn to modern business practices and implement quality processes in education. Such processes include the use of statistical approaches to school accountability. School managers, therefore, must learn to use measurement techniques to understand the people and processes in the work units of the school. The manager must understand variation and use statistical calculation to learn which staff members need special help and which processes need changing.

This book describes how measurement, costing, and goal setting techniques can be used in schools in the quest for improvement of educational processes. While these techniques are only a part of the overall quality process being advanced at FVTC, they are most critical. All quality experts concur that measurement, goal setting, and costing are significant to quality improvement. W. Edwards Deming, renowned management consultant, feels that measurement is the most critical of all processes. He feels that management should have a knowledge of statistics upon which to make decisions. Determining costs of quality is not nearly as significant as measuring and controlling

processes using statistics, he believes. Philip Crosby, on the other hand, feels that costing is the best and the only true measurement of the quality process.

While quality theorists offer a variety of approaches to measurement, they agree that continuous research and evaluation are necessary. Goals, they concur, should be based on measurement, since measurement techniques determine if goals have been reached. Therefore, quality improvement requires a continuous cycle of measuring, goal setting, and costing. This book describes a model being tested at Fox Valley Technical College to measure and cost quality. It is a plan which is unique to education, and educators will find the language and jargon familiar. Those who carefully implement this plan will be able to provide answers to questions about the successes and improvements made in schools using modern methods of quality improvement.

Quality improvement requires a continuous cycle of measuring, goal setting, and costing.

The annual organizational climate survey is one source of information in the measuring/costing process. The data is reviewed in the model's cyclical process with an eye toward fine tuning systems and procedures.

Measurement/Costing Model

The model contains seven main activities which lead to the identification and selection of problems, the measurement and costing of problems, and the establishment of goals. The activities are cyclic, undergoing constant review and modification. Each activity is also subject to change based on new variables. Table 1 illustrates this model.

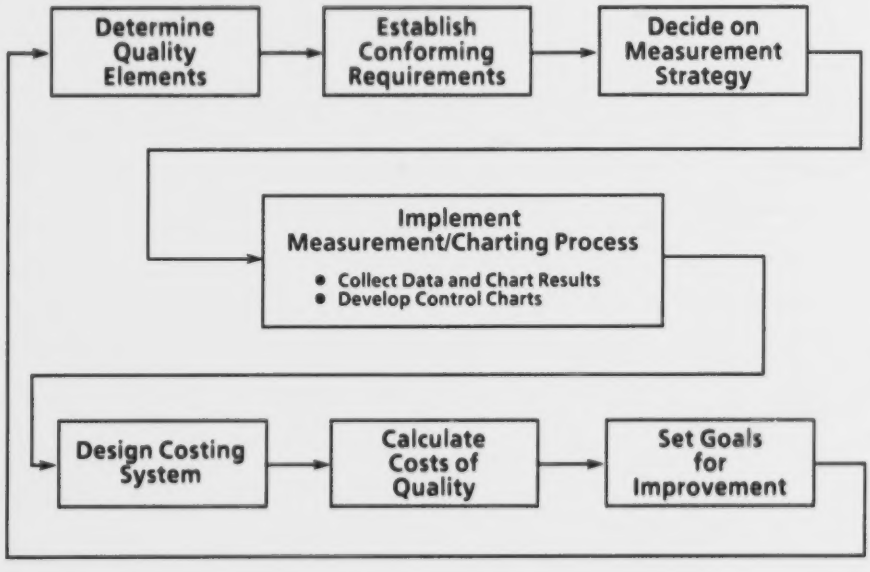


Table 1 - The Cyclical Process of Measuring, Goal Setting, and Costing Quality

The staff at FVTC are just beginning to use charting techniques and statistical data during the problem-solving process. While some staff members have received advanced instruction in statistical process control, most have only a limited knowledge of the use of statistics in measurement. However, it is significant that faculty, technical staff, and managers are starting to use data to analyze processes and make decisions, rather than deciding things arbitrarily.

Determine Quality Elements

Defining the key elements of quality in the school is an important first step. These elements serve as the basis for the schoolwide goal setting, measurement, and costing activities which will occur. It is important that everyone working in the school knows and understands the elements which are approved by the Quality Improvement Council based on input from the various quality committees. The elements target the global aspects of the school which will assist in the evaluation processes that periodically occur. Therefore, great care should be taken to not only define the elements but also to communicate them to everyone in the organization. Seven quality elements were developed by the Quality Improvement Council at Fox Valley Technical College. A summary of each is given below, and each element is shown in Appendices A through F together with conforming requirements, measurement strategies, and costs of nonconformance.

It is important that everyone knows and understands the elements of quality.

Human Resources (Appendix A)

The most important resource of any organization is its employees; and in education, competent faculty are crucial to the learning/teaching process. Support persons, including technical staff, counselors, managers, and other professionals, also provide valuable services to students and other school customers. The organization has the responsibility to work with each person to enable them to meet the preestablished requirements for their job. Each individual should be provided opportunities to interact with others in ways in which

mutual respect for one another and the organization is nurtured. In return, each person is expected to display behavior which creates a positive attitude, enthusiasm, loyalty, and commitment to goals, objectives, and mission of the school. However, there will be no long-term improvement in processes with this alone. The manager must create an environment in which people have joy in their work. The manager must also statistically study and help the staff improve. That type of improvement will be long lasting.

A quality work environment exists which is supportive of people doing their job as best they can; with the goal of doing it right the first time. Everyone strives to meet the educational and service needs of their customers. The organizational climate fosters an attitude of respect for one another and a desire to maximize each person's potential.

The goal is do it right the first time.

The environment is safe, clean, technologically current, comfortable, and attractive for educational and administrative functions.

Curriculum and Instruction (Appendix B)

Next in importance to qualified instructors is the curriculum used to support the learning process. A competency-based format is required since occupational instruction is based on job requirements.

Competency-based curriculum:

- establishes the students' and instructors' roles in the process of instruction.

- communicates what is to be accomplished in instruction.
- specifies resources required to accomplish the learning goals and tells how the learning will be evaluated.

When the curriculum has been described, a management system is designed to support the teaching/learning process. This process includes all the people and all the support systems to ensure that learning occurs in an effective and efficient manner. The use of a multiple-entry, multiple-exit system is advocated since it permits the learner to enter instruction at various times and exit when the competency-based curriculum requirements have been met. At Fox Valley Technical College, this system is called "Perpetual Enrollment/Graduation" (PEG).

Planning (Appendix C)

The overall planning process is an important function of every school district. It encourages everyone to think creatively and project to the future. It is the continual process of making decisions in a systematic way based on analysis of the future and statistical study. This analysis and statistical study should be the basis for reallocation of resources in a school. Therefore, planning and statistical analysis is used as a cornerstone for the establishment of operational goals and individual objectives. Participation by all staff, at all levels, is required. An important factor is the need to link this planning and analysis with the budgetary process in order to provide resource allocation.

The planning process encourages everyone to think creatively and project to the future.

Use of Technology (Appendix D)

Effectively merging instructional, administrative, and office information systems enhances the contemporary school. The integration of micro and mainframe computers into vast networks is possible while maintaining the individuality of generic terminals and micro work stations. An occupational education system that uses a competency-based curriculum with perpetual enrollment and graduation relies on maximum use of technology with an effective, automated information system. A carefully planned, computerized network, together with an effective and comprehensive media and telecommunications department, enables the school to meet conforming requirements while operating a flexible instructional system.

Marketing (Appendix E)

The marketing process aligns the mission, goals, and objectives of the institution with activities which are timely and effective. Marketing permeates all aspects of the organization including employee, board, and customer relations. This integration results in the development and refinement of an organizational image which is positive and clear to external and internal publics. A quality image is developed with successful graduates and satisfied customers. Therefore, marketing is everyone's responsibility.

Marketing permeates all aspects of the organization . . . marketing is everyone's responsibility.

Customer Service (Appendix F)

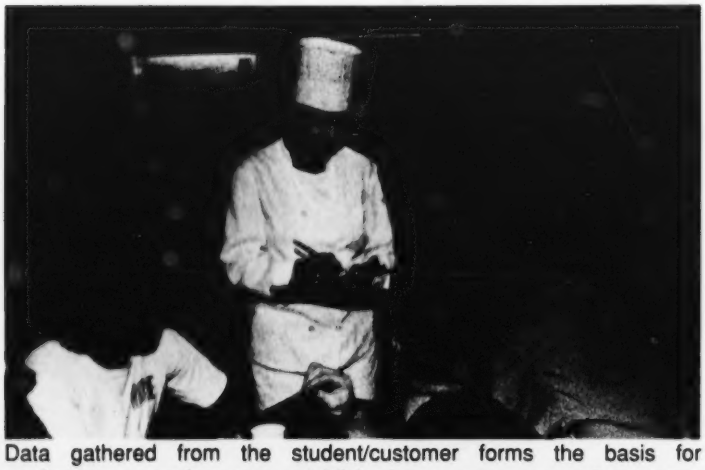
The key to the success of any school is meeting the needs of its customers. The school has an obligation to its current students/customers, graduates, and potential enrollees to maintain a

quality image in the community. This image must be clearly stated and understood, as well as described in the requirements of this element.

A total organizational approach that promotes quality of service as perceived by the customer should be the driving force in the operation of each service department of the school. The approach requires:

- customer-oriented, "front-line" people.
- a management team supportive of "front-line" people.
- customer-friendly systems designed for the convenience of customers.

The customer's perception of quality is the bottom line. From the "sound" of a smile to attention to every detail involved in the product/service, the customer positively or negatively assesses quality.



Data gathered from the student/customer forms the basis for conformance requirements established to meet or exceed customer needs.

Establish Conforming Requirements

Once the quality elements have been selected for the organization, the criteria for each should be carefully defined. These criteria are called conforming requirements, and they become the basis for schoolwide measurement, costing, and goal setting.

Since conforming requirements are so critical to the quality process, they should be written with great care and undergo constant review. Each conforming requirement should contain a measurement standard which tells what individuals will do and, if possible, indicates the conditions under which the activity will be performed. Once established, the requirements should be communicated to everyone in the school.

The quality elements selected by Fox Valley Technical College are shown in Appendices A through F. Using suggested strategies or tools, the requirements are measurable. For example, Appendix E contains the conforming requirements of the Quality Element *Marketing*. Conforming Requirement 3 reads as follows:

Once established, conforming requirements are communicated to everyone in the school.

> *"There is a written marketing plan that is current and in support of the District Marketing Plan for each instructional and administrative unit."*

To determine whether this requirement is met, a measurement strategy or tool is listed. In this example there are two--Instructional Audits and North Central Evaluations. During these activities, each department

reports on its plan and shows how it is used and how the department plan supports the school's plan.

Another example can be found under Quality Element *Curriculum and Instruction found in Appendix B. Conforming Requirement 11 states:*

"All classes begin and end on time."

This requirement is measured on the annual Student Satisfaction Survey with an item asking about the instructor's punctuality in starting and ending classes.

It is soon obvious that some of the quality elements and the accompanying conforming requirements are not directly applicable to all people in each work unit. For example, the requirements for Curriculum and Instruction are likely to be most appropriate for faculty and the instructional managers. On the other hand, many of the conforming requirements for the Work Environment (Human Resources) quality element will be most applicable to the school's maintenance department. Since all school employees are a part of the process, it is desirable that all are aware of the elements and their use throughout the school.

Decide on Measurement Strategy

After the conforming requirements are written, the next activity involves deciding on a strategy for measuring them. This should be done as soon as possible since all school employees need to know the measurement mechanism. In many cases the processes which are appropriate as measurement strategies are already in use. At Fox Valley Technical College, a number of different strategies are used, and, in many cases, there is more than one measurement strategy for each conforming requirement. While the strategies have varying degrees of valid statistical credibility, all are indicators of improvement. A list of those used is provided and explained below.

Instructional Audit

Instructional audits provide a review of each instructional program conducted by an outside team of experts from business, industry, and other schools. Each program is audited at least once every seven years. An annual "mini-audit" of each program is conducted to identify programs which are experiencing problems.

North Central Accreditation Evaluation

The North Central Accreditation Evaluation at FVTC is an intensive self-evaluation and review conducted at intervals of five to ten years, depending on the conditions reported in the prior accreditation visit. The quality process, together with the measuring, goal setting, and costing activities described in this

book, becomes the basis for the self-evaluation study for each accreditation review. Properly applied, these components provide an ongoing analysis of school improvement.

Student Satisfaction Survey

Students are the primary customers of the school, and surveys are conducted to find out how well the school is meeting student requirements. At Fox Valley Technical College, student evaluations are conducted in each class in order to give all students an opportunity to evaluate the instruction. In addition, an annual, campus-wide student satisfaction survey is conducted.

Organizational Climate Survey

Everyone who works in the school has the opportunity to annually complete an organizational climate survey which focuses on the quality of services provided by managers as well as the work environment of the school. Climate surveys may have limited value depending upon the conditions in the school or in the department when it is administered. The analysis of this survey data is, however, the vehicle for promoting greater communications between employees and their managers and for using corrective action as needed to improve problem areas.

Postgraduate Satisfaction Survey

Employers of FVTC graduates and educators from four-year schools in which students enroll upon graduation provide feedback concerning the effectiveness of instruction. This type of survey is conducted annually in order to note changes which

are important to improvement of the overall operation of the school.

Indicators of District Health

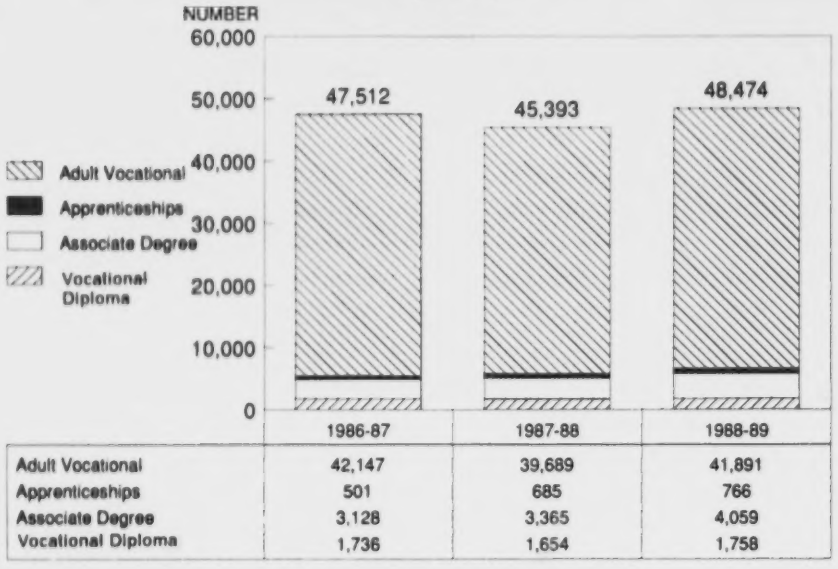
A monthly report made available to the FVTC school board and internal staff defines concisely and graphically the major elements of the school. Comparative data related to enrollments, withdrawals, graduation, and other demographic information about the system and its customers are included in the Indicators of District Health. Table 2, shown on page 18, is a graphic illustration of this type of report.

Other Reports

Numerous other reports including attendance records, accident reports, advisory committee minutes, and the school budget are instruments used as part of the measurement strategy. In addition, error-cause removal (ECR) reports are used at Fox Valley Technical College as vehicles for faculty and staff to identify problems. These are good indicators, but generally require further study and analysis. These measurement tools or strategies are identified for each conforming requirement of the quality elements. Those selected at FVTC are shown in Appendices A through F. Many existing reports and surveys were considered for their appropriateness as measurement strategies for the requirements. Where no appropriate measure existed, one was developed.

Summary

It is important to write clear, measurable conforming requirements for each quality element. The requirements are measured in a variety of ways using different tools or strategies--surveys, audits, evaluations, reports. In addition, wherever possible, costs are calculated for each conforming requirement. The costing model itself is explained later.



	1986-87	1987-88	1988-89
Adult Vocational	42,147	39,689	41,891
Apprenticeships	501	685	766
Associate Degree	3,128	3,365	4,059
Vocational Diploma	1,736	1,654	1,758

Table 2 - Indicators of District Health (Headcount)

Source: FVTC Summary by Program (Ungraded)

Implement Measurement Process Techniques

There are some basic steps to follow in the problem-solving process at the work unit level. The first is to decide which problem should be addressed and to arrive at agreement as to the scope and extent of the problem. Next is to develop a complete picture of all the possible causes of the problem. After the picture is complete, the team tries to reach agreement on the basic cause of the problem. Then, it is necessary to work toward an effective solution to the problem and finally, to implement the solution and use monitoring procedures and charting techniques to make sure the activity being measured remains under control. Statistical quality control processes provide the educator with tools to accomplish these steps.

Statistical quality control techniques are used to measure the performance of an operation or process and express it in numbers. Once the statistics are collected, it is possible to determine if the process is running smoothly. Walter A. Shewhart, a statistician for Bell Laboratories, developed these techniques to bring processes into "statistical control." He defined the limits of variation through the setting of acceptable highs and lows. The entire process of measuring, charting, and recognizing when to act and when to leave alone is known as statistical process control (SPC). Using this technique, performance can be measured both before and after corrective action has been taken. Since the goal in education is to improve the quality of instruction and services, there must be stable processes because only then can there be confidence in what the quality level is. Statistical methods of quality control provide a

The process of measuring, charting, and recognizing when to act and when to leave alone is known as statistical process control (SPC).

way to picture and control quality. The greatest value of these techniques comes from using them continuously to control quality. They must become a way of life to be effective.[2]

Charting permits analysis of the variation in a dimension caused by all parts of the total process.

When using quality control techniques, charts are made based on the information which is gathered. The information used is variable data which shows if the process meets conforming requirements or standards. Charting points out the defects which need to be reduced or eliminated. Charting permits analysis of the variation in a dimension caused by all parts of the total process. It's a communicating tool which tells the person when to act and when to leave the process alone.

There are a number of problem-solving tools for improving processes in the school setting. Three basic and powerful tools are brainstorming, cause and effect analysis, and Pareto analysis. These are especially helpful in solving chronic problems. However, before these tools are used, it may be necessary to use a flow chart to show the team how the process fits into the total problem-solving activity. This flow chart may be developed by the team leader or there may be a sample flow chart developed for the entire school. The flow chart used at Fox Valley Technical College is found in Table 3 on page 21. It graphically illustrates how the process works.

The team uses brainstorming techniques to decide on a problem, to study and gather input on its causes, and to flow chart the problem. Brainstorming encourages group participation and allows room for creativity and new ideas. It is a group problem-solving method which taps people's creative ability to define and solve problems. It helps people to feel comfortable

contributing to the group and developing trust in each other.

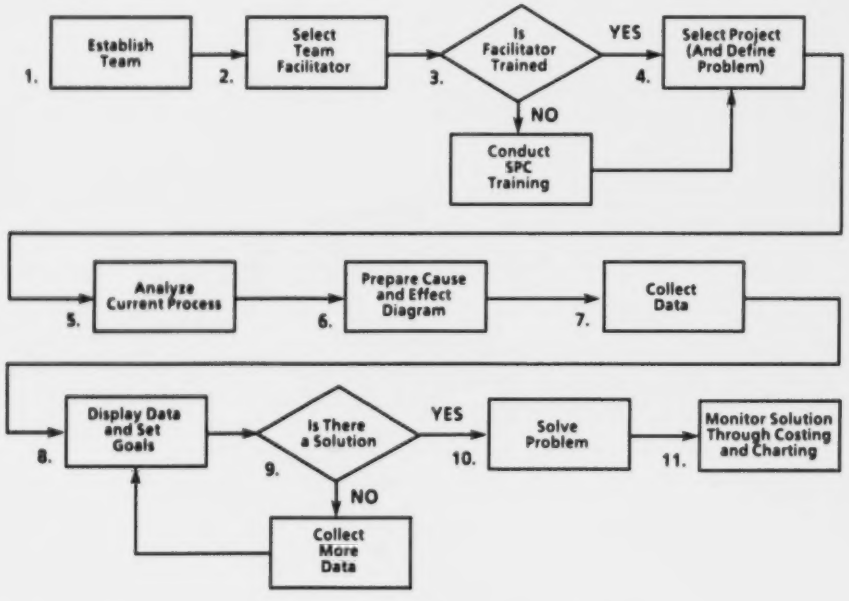


Table 3 - SPC Problem Solving Process Flow Chart

The team facilitator leads the brainstorming process. The facilitator exercises enough control over the group to keep it on track and at the same time encourages total participation by team members. In the process, each person takes a turn to express an idea which is recorded. Wild ideas are encouraged and criticism is not allowed as the ideas are presented.

Since the list of ideas which evolves is a mixed-up array of thoughts, some organization is required. This is accomplished through the use of the cause and effect diagram. This diagram shows in picture form how the

ideas from brainstorming relate to one another. It arranges disjointed ideas into a logical order so that they can be better organized. The cause and effect diagram, sometimes called an Ishikawa or "fish bone" diagram, helps to look at ideas, establish relationships, and examine factors that may influence a given process or evaluation.[3] Table 4, shown below, is an example of a Cause and Effect Diagram.

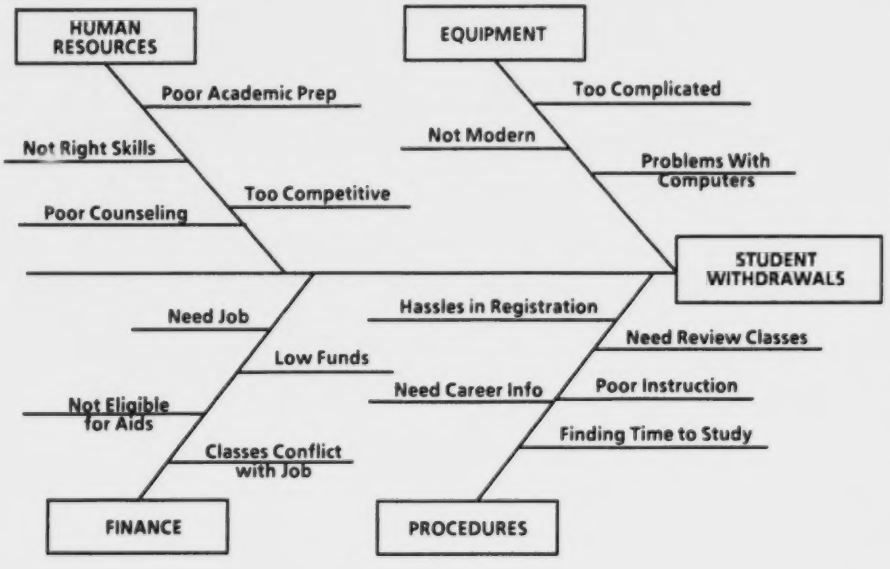


Table 4 - Cause and Effect Diagram Showing Possible Causes of Student Withdrawals in the FVTC Business Division

Collect Data and Chart Results

Once the problem-solving goals have been set for the work unit, a plan should be established to collect data and chart results.

There are a number of factors to consider to ensure collection of the correct data. First, it is essential to make clear the purpose for which data is to be collected. Using carefully defined conforming requirements, the data collected is used to provide a basis for action or change to occur. The data collected should help identify what defects are most prevalent and what factors are causing defects.

Once the purpose is defined, the next problem is to choose the sampling technique. Samples desired, frequency of collection, and sampling method to be used must be determined. It is essential that there be an awareness of possible errors in measurement and efforts made to keep errors at a minimum. Different readings may result from using different measurement instruments and/or from different people reading and interpreting the data. There may be, in fact, existing reports which identify the kinds of defects which occur in schools. While in some cases sufficient data is available, most often additional data collection is necessary. However, it is extremely important to eliminate measurement variation early since bad data is worse than no data.

A data sheet or check sheet is used to collect the information you want. It is an organized form which puts the data in the way you want it. Any form is acceptable

as long as it does the job. Table 5, shown below, is an illustration of a sample data list which has been developed from data collected through withdrawal reports.

DATA SHEET - FVTC **Date:** April 10, 1989

Data Collector *Robert Darula, Dean of Student Services*

Collection Strategy *Counselor Withdrawal Reports*

Date	Number of Program Withdrawals					
	Business	Technical	Service	General	Econ. Dev.	Totals
January	16	9	2	20	-	47
February	18	36	8	10	3	75
March	42	17	38	32	-	129
April	6	22	3	3	-	34
May	28	32	-	12	-	72
June	3	2	-	-	-	5
July	-	-	-	-	-	0
August	21	24	2	12	-	59
September	27	37	-	20	1	85
October	19	11	1	10	1	42
November	25	5	2	14	-	46
December	10	48	52	37	-	147
Totals	215	243	108	170	5	741

Table 5 - Data Sheet Used to Collect Data Needed to Measure and Cost Quality Defects

The next step is to decide how to arrange the data. Since data are collected in various forms, different formats are used to display the data. There are a number of display charts which may be used to arrange and display data. Two of these, histograms and Pareto charts, are explained in the following pages.

A histogram chart is used to identify overall tendencies. It is a simple graph with bars and therefore is also called a bar graph. Within a frequency table, data is sequenced and then displayed on a graph which shows the shape of distribution of the data. A histogram is built

by creating a frequency distribution of the data collected. After the frequency distribution is prepared, a graph is drawn with class intervals on the horizontal axis. The vertical axis shows the sum of the observations or calculations within each class interval. Once drawn, the histogram shows the shape of the distribution. Often times the histogram shows a symmetrical or normal distribution. This has most of the instances in the middle, with a fairly equal distribution on both sides. Other patterns which emerge on a histogram include bimodal which is characterized by two distinct groupings of data; patterns which have data skewed either right or left; and, random data in which no distinct pattern occurs.

Table 6, shown on page 26, is a chart with a random pattern. Note that the pattern of school withdrawals on this chart shows no distinct pattern; however, the data is valuable in that it identifies two months, March and September, having the greatest frequency. Further analysis is in order. In fact, the data could probably be best shown using a Pareto chart.

A Pareto chart is a bar graph that shows the frequency of problems in decreasing order of significance. This type of chart indicates which problem occurs most frequently and should, therefore, be handled first. Table 7, shown on page 27, is a graphic illustration of a Pareto chart which shows the reasons why students withdrew from Fox Valley Technical College. It is used to determine priorities. The Pareto chart is sometimes described as a way to sort out the "vital few" from the "trivial many." Besides displaying bars in order of frequency from left to right, an axis is drawn to show percentages. Note that the percentage for each additional bar is added to reflect 100 percent of all cases.

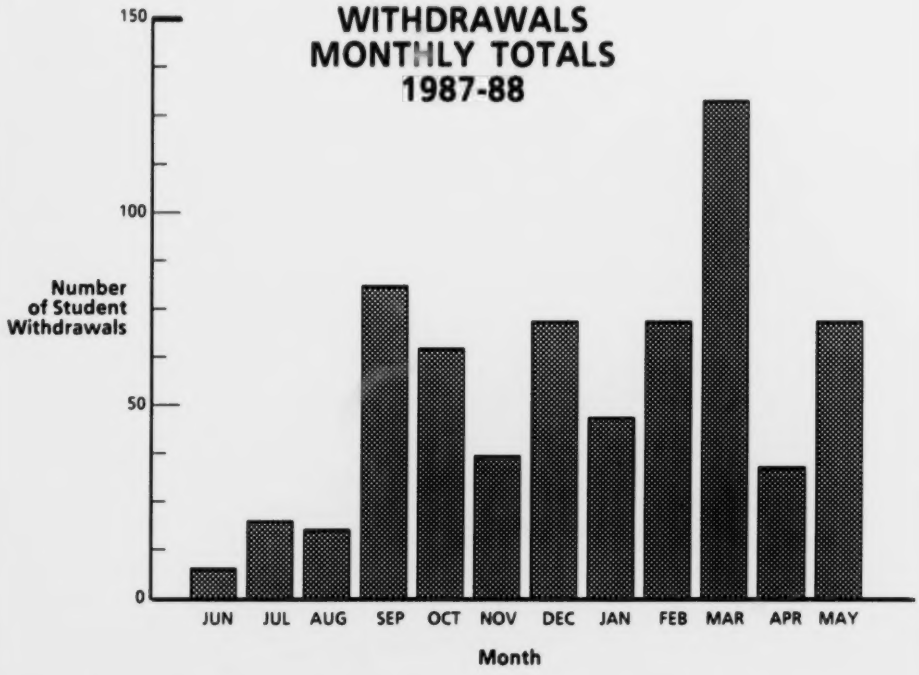


Table 6 - Chart Showing the Number of Withdrawals for Each Month

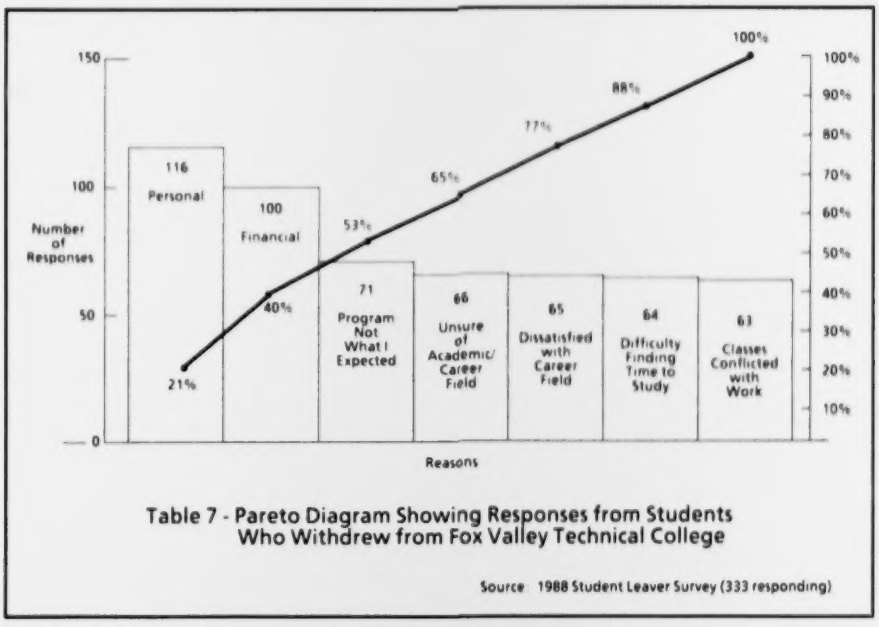


Table 7 - Pareto Diagram Showing Responses from Students Who Withdrew from Fox Valley Technical College

Source: 1988 Student Leaver Survey (333 responding)

A Pareto chart is helpful because it identifies the major problems. The tallest bar is clearly the major reason and the principal focus of the chart.

Other types of charts are used to display information and various types of sampling techniques are used to gather data. The method is influenced by the process which is being examined and the sophistication of the observer and charter. Whenever possible, data should be collected by the person who controls the activity because that person can also initiate corrective action in real time. Using check sheets, calculators, computers, and existing data, the person responsible for the activity looks at the data and, in cooperation with his/her manager, interprets the information in an effort to improve the process. The person in charge of the process is best equipped to identify special causes of variation and then eliminate them.

Whenever possible, data should be collected by the person who controls the activity because that person can also initiate corrective action in real time.

Some examples of charts which have been developed at Fox Valley Technical College appear in Tables 8 through 12. These charts may not be "classic" examples of those commonly used in industry. However, they are useful in that they worked for the department involved, and that's what really matters. A brief explanation of each follows.

Example 1 - Student Preferences for Program Schedule

In early 1989, the Electromechanical Department problem-solving team undertook the challenge of examining their course offering schedule to determine if the entry system was satisfying the needs of their student customers. The program, when initiated based on perceived demand, was structured to offer morning, afternoon, and evening sections. Upon close examination, it was discovered that, while the morning and evening sections had numerous people on waiting lists and were continuing to run at capacity, the afternoon section had a much smaller waiting list; and, on occasion, was running at less than capacity.

The problem-solving team developed an instrument to survey the students on the afternoon and evening waiting lists to determine if they might be interested in enrolling in the evening section if an additional section were offered.

The basic information gathered, as shown on the charts on Table 8 on page 29, clearly established preferences of the student customers. As a result, the afternoon section was discontinued and an additional evening section was created from 3:30 to 10:00 p.m., Monday through Thursday.

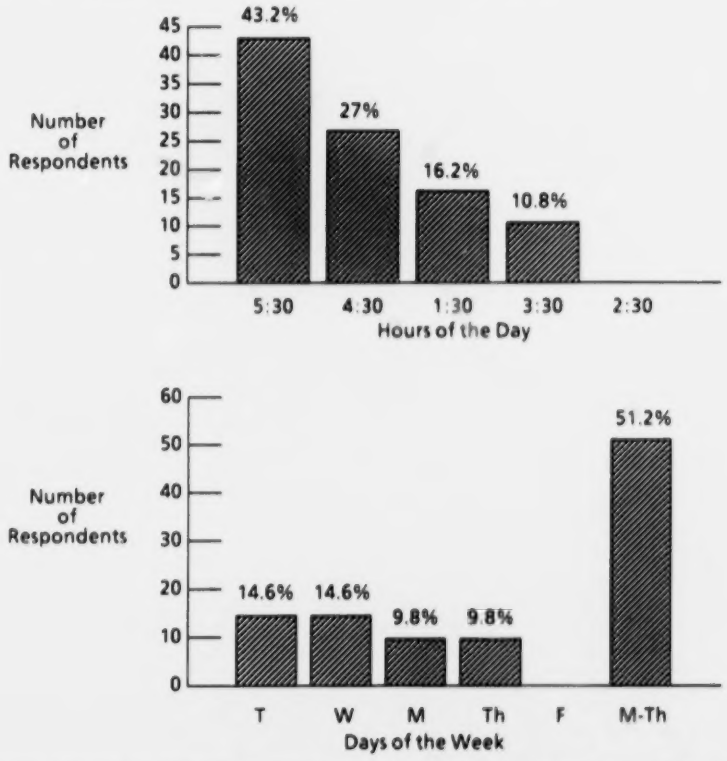


Table 8 - Pareto Charts of Earliest Starting Time and Days Available for Student Customers

Source: Jim Bourassa, FVTC
Electromechanical Instructor

Example 2 - Analysis of Cafeteria Utilization

Table 9, shown on page 30, is a chart developed by the Food Service instructional problem-solving team to determine if cafeteria expansion was justified. The chart and data focuses on a "typical" week of cafeteria utilization from 10:30 a.m. to 12:30 p.m. It was discovered, through the charting process, that on no day during that week did the cafeteria reach its maximum capacity. Based on the data, the space already allocated was determined to be adequate. Continued

charting will be done to determine if that decision was indeed valid.

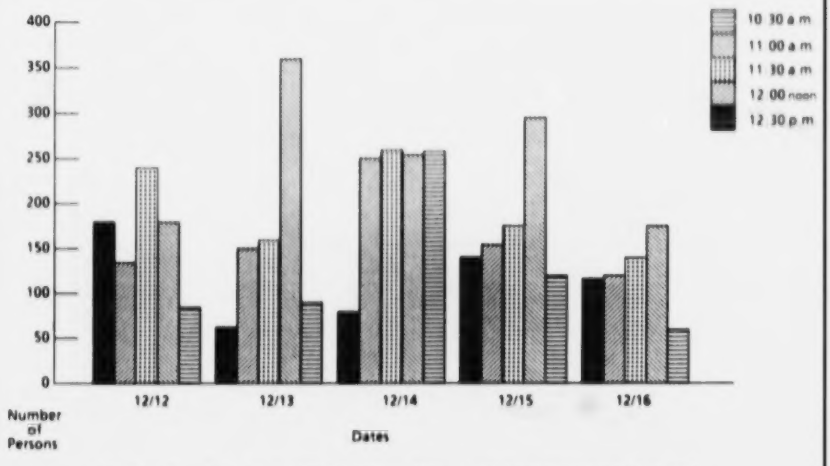


Table 9 - Cafeteria Utilization, Week of 12/12 to 12/16, 1988

Source: Helen Dean, Instructor, Food Service Department

Example 3 - Operational Status of Computer System

A third example, a "custom-made" example of a run chart, was developed in the school Registration Department. Table 10, shown on page 31, is a sample chart which was used to measure computer status as perceived by a system user (internal customer). Developed and plotted by the Registration Clerk, these charts are being used to determine whether there is a pattern between time of day and/or day of the week in which the registration computer system is either slow or down. Following three months of data collection, the data receives initial analysis by the Registration Clerk. It is placed on control charts and forwarded to the College Data Processing Department for appropriate corrective action.

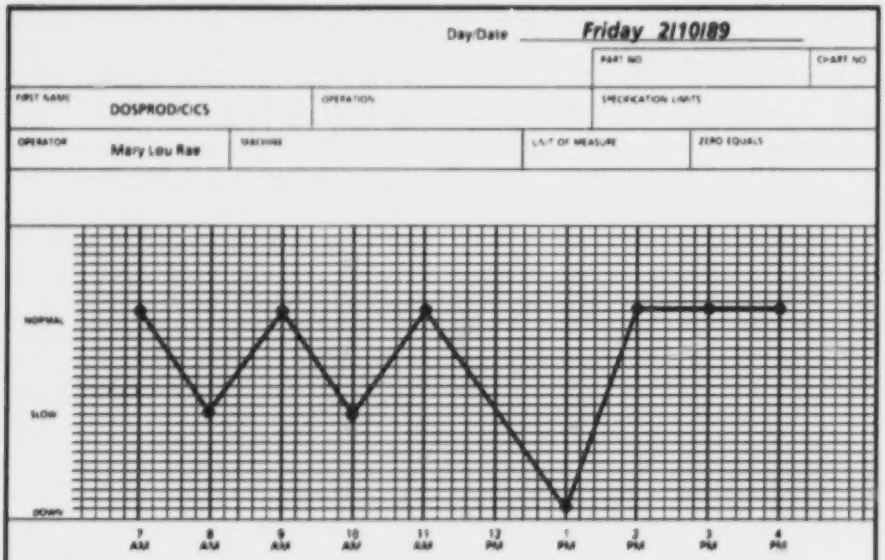


Table 10 - Run Chart Showing Computer "Slow" and "Down" Time for Friday, February 10, 1989

Source: Mary Lou Rae, Registration Clerk

Example 4 - Student Awareness of Safety Guidelines

An additional example of a "custom-made" run chart used at FVTC in the quality improvement process was developed by the instructor in the Parts Specialist program. It presents a "picture" of the data obtained from a questionnaire developed to obtain customers' perceptions of his/her training in a particular course.

The instructor discovered that a problem existed. The chart which was developed is shown in Table 11 on page 32. Based on that data, the teacher improved his methods of making students aware of accident and safety procedures. Improvement became evident and continued until the point in January 1989 when the chart showed that 100 percent of the students were aware of accident and safety procedures.

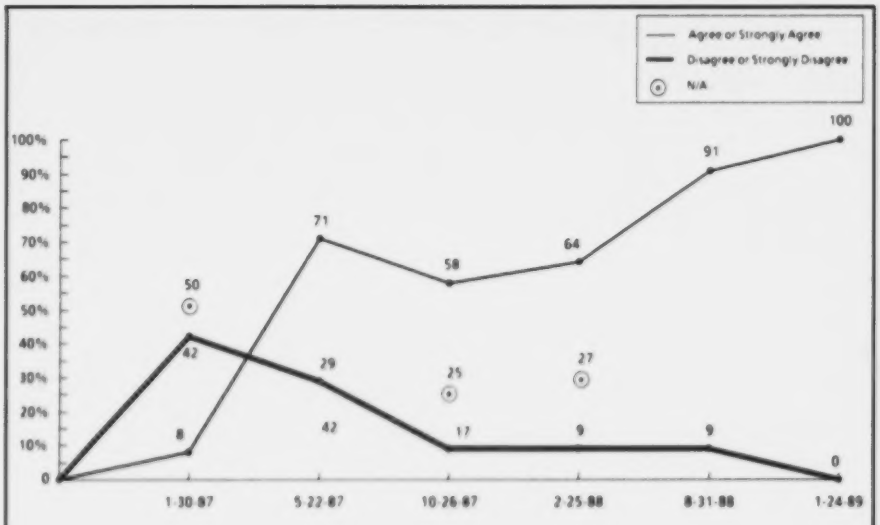


Table 11 - Run Chart - Students Made Aware of Accident and Safety Procedures

Source: Dan Ost, Instructor, Parts Specialist Program

These charts are used to illustrate that charting, to be effective, does not have to be the result of an elaborate system of statistical processing and analysis. Teachers and service department staff can use these and other techniques of data gathering and charting to initiate corrective action and solve problems. Basic problem-solving techniques and charting practices lead toward more sophisticated charting and statistical analysis.

A number of FVTC faculty and staff have been trained in using statistical process control (SPC) techniques. Several were formally trained at workshops conducted by statistical experts, including Dr. Deming. Most of them are teachers who are certified by the American Society of Quality Control (ASQC) and now teach SPC to business and industry in the region. In addition, 26 faculty members and managers were trained locally. A major goal is to train all managers and several more

instructors and staff to use these basic statistical principles of building and analyzing control charts.

One problem which is being analyzed at Fox Valley Technical College is the student withdrawal process. Information concerning student withdrawals is gathered on a daily basis and compiled into monthly reports. These monthly student withdrawal reports are used with data on program enrollments to determine the percentage of withdrawals in each program.

Table 12, shown on page 34, is a frequency distribution chart which lists each program in the Service Division and shows the number of withdrawals for each during a six-month period. The information is gathered by each instructional division.

Using these charts, which can be developed on a daily, weekly, monthly, or semester basis, managers and faculty can conduct further study to determine how to improve student retention. The staff may decide to examine factors such as the following to assist in improving the process:

- entry levels of students using G.P.A.'s (Grade Point Averages) from high school
- basic skill levels of students using ACT (American College Testing) or SAT (Scholastic Aptitude Test) scores
- career development and counseling experiences of entering students

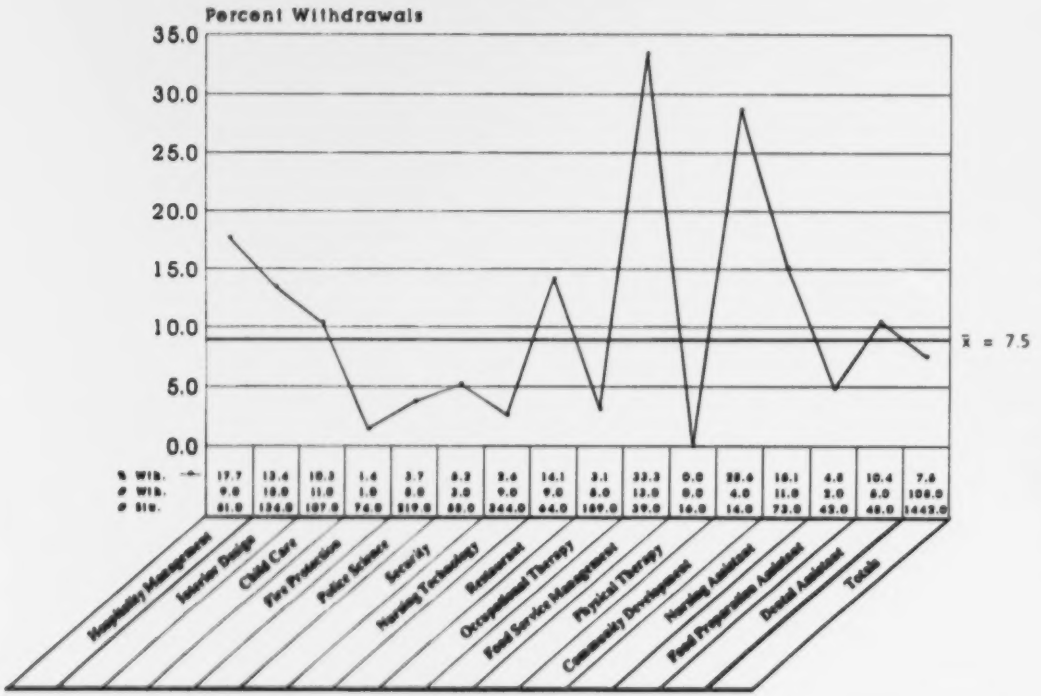


Table 12 - Frequency Distribution Chart Student Withdrawals Service Division

Develop Control Charts

Control charts are also used to examine and reduce the number of student withdrawals at Fox Valley Technical College. Control charts are graphic illustrations of a process or attribute showing plotted values with statistically determined central lines and upper and lower control limits. They are used to determine whether the process has been operating with acceptable limits. They are tools which can provide reliable information upon which appropriate decisions can be made. Control charts provide information which is valuable in reducing variation through careful analysis of the items which are statistically beyond the upper or lower limits--"out of control." Control charts lead to improved quality and productivity because the data helps to show special causes which are either adjusted or which may lead to changes in the process itself.

Control charts give faculty, service staff, and managers common graphic and numerical communication tools. School managers, skilled in using and interpreting control charts, can assist others in the corrective process through identifying needed action based on data, not on guesswork.

With control charts needed action is based on data, not on guesswork.

There are different types of control charts and many books have been written on their use and interpretation. One resource is the Transformation of American Industry Training System which was developed to increase the capacity of our nation's community colleges for helping industry improve quality. While the training materials were developed for use in business and industry, they may be appropriate for use by educational managers to learn the basic techniques of statistical process control.[4]

An example of one type of control chart being used at Fox Valley Technical College is found in Table 14, shown on page 37. The p-chart helps in controlling defects in services and is useful in education. It is used when the sample size (n) varies. The control chart shown in Table 14 provides information which may be useful in monitoring student withdrawals. It provides data related to the average number of withdrawals in a specific program for the past three years, reported on a monthly basis. The percentage of enrolled students which withdraw each month is presented and upper and lower limits are shown. The data for this control chart was reported on a chart shown in Table 13, below. The information was subsequently plotted on the control chart described above and shown in Table 14. Note that this control chart shows that this is not a stable process.

Program Accounting Inspection Review of Withdrawal Forms

(1987-89 Averages)

Month	Average # Students 1987-89	Average # Drops 1987-89	Fraction Defective p
July	95	1.7	.018
August	101	6.0	.059
September	218	2.7	.012
October	282	3.3	.012
November	286	5.1	.018
December	272	3.0	.011
January	271	4.0	.015
February	262	9.0	.034
March	259	2.7	.010
April	280	2.0	.007
May	279	6.5	.023
Totals	2,605	46	.219
Averages	236	4.18	.020

Table 13 p Chart Showing Number of Withdrawals and Fraction Defective p

Table 15, shown on page 38, shows another sample Control Chart which is called a "U" Chart. Note that the chart shows the limits of reasons for withdrawal by

instructional division. Using "U" chart calculations, the chart displays the average number of reasons given by each person who withdrew. Then, upper limits and lower limits are calculated. Samples can be taken at regular intervals to determine if the process is changing fundamentally. When analyzing this chart on a regular basis, the manager can see if things are getting worse (reasons increasing) or if there is less dissatisfaction (reasons decreasing).

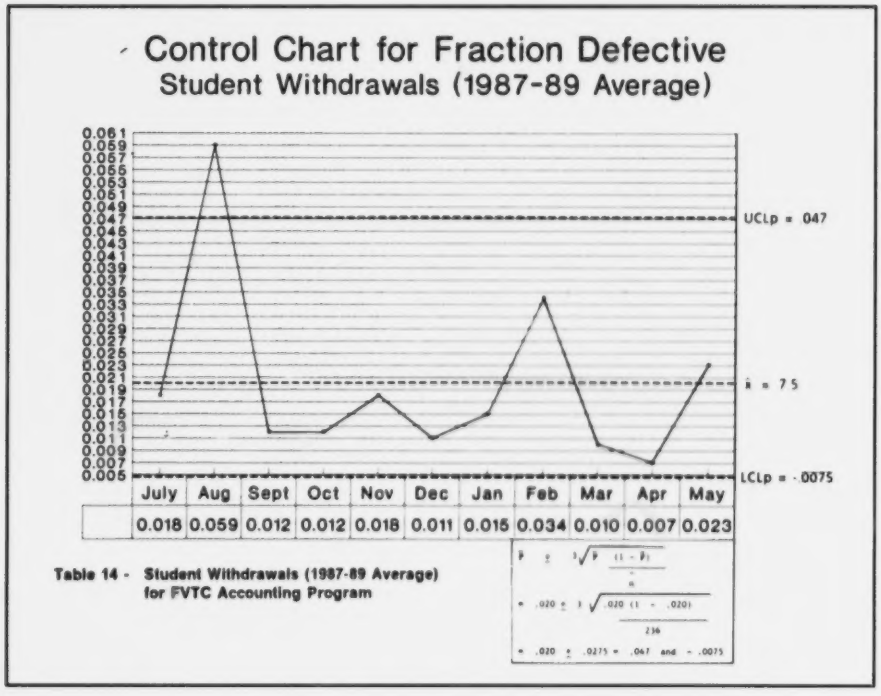


Table 14 - Student Withdrawals (1987-89 Average) for FVTC Accounting Program

$$\bar{p} \pm 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

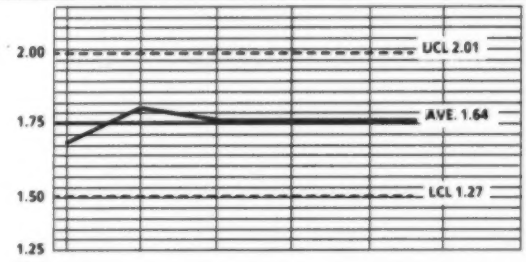
$$= .020 \pm 3\sqrt{\frac{.020(1-.020)}{236}}$$

$$= .020 \pm .0275 = .047 \text{ and } -.0075$$

Simply stated, a control chart is a graph with statistically determined limit lines which include upper control limits, a central or mean line, and lower control limits. These lines, shown on the chart, become keys to process analysis. From these process analysis control charts, other charts used for process control can be designed. These control charts depict what changes in data occur over time and also permit the study of the impact of

various factors in the process that change over time. They show whether any of the points fall between or outside the limits or form unnatural patterns.

CHART	DEFECTS PER UNIT (U)
PLOT POINT	$U = \frac{\#\text{ DEFECTS}}{n}$
CENTER LINE	$\bar{U} = \frac{\text{TOTAL \# DEFECTS FOUND}}{\text{TOTAL PIECES SAMPLED}}$
CONTROL LIMITS	$\bar{U} \pm 3\sqrt{\frac{\bar{U}}{n}}$
SAMPLE SIZE (n)	CAN VARY, BUT CONTROL LIMIT CALCULATION BECOMES VERY DIFFICULT (EVERY POINT)



REASONS FOR WITHDRAWALS	TECHNICAL	BUSINESS	H&H SERVICES
Classes Conflicted with Work	30	15	18
Difficulty Finding Time to Study	22	29	13
Dissatisfied with Career Field	18	29	18
Financial	37	34	29
Personal	33	49	34
Program Not What I Expected	26	24	21
Unsure of Academic/Career Field	22	29	15
Total Defective Units (NP)/Defects (C)	188	209	148
Proportion (P U)	1.58	1.69	1.64
Sample Size (N)	119	124	90

Table 15 - Sample "U" Chart Showing Average Number of Reasons with Upper and Lower Limits

The design and analysis of control charts does not require advanced statistics; however, before they are used, a review of statistical process control techniques is needed. Books by Deming, Juran, and Ishikawa have illustrations and explanations of statistical techniques used in establishing limits on control charts.[5]

Control charts perform many functions which may help schools improve their quality. They can provide a history of many processes used in education. They can measure quality progress and improvement and point out trouble areas, especially in service departments. They are also effective as presentation and information systems. Since they are control devices, they also

provide valuable information for analysis and ultimate action. Most of all, control charts display variability and give school managers objective statistical information which will help in decision making. A quality information system is needed to ensure that problems are being solved analytically, goals are attained, and prevention of errors occurs. Statistical process control provides the system.

Statistical process control provides the system to ensure that problems are being solved analytically, goals are attained, and prevention of errors occurs.

The general goal of control charting is to focus work on some definite change in the process for improvement, through the creation of less variability within the control limits. Management has the responsibility to provide the necessary leadership which empowers others to be striving toward achieving statistical control of processes by analyzing factors and looking at possible causes of those things which are statistically out of control. The statistically-oriented manager uses the data to help determine which staff under his/her jurisdiction need special help.

While some of the charts presented in this book may invite technical criticism from SPC experts, they are preliminary attempts to incorporate industrial applications in educational evaluation. The key concept being stressed at Fox Valley Technical College is that it is no longer acceptable to use subjective analysis when making decisions to modify processes. Managers, teachers, and technical workers are being encouraged to use data collection, charting, and other statistical techniques to realize the benefits obtained from the dynamics of averages. As training in statistical techniques continues, and as educators become more comfortable with these industrial applications, the technical competence will lead to more appropriate applications.

The thoughtful design of costing systems through the careful identification of measurement criteria helps to put the dollars and sense into the process.

Design Costing System

In the past, the cost of quality has been used only as a means of measuring defects and errors in the manufacturing plant. Seldom has it been used as an evaluation tool. Fox Valley Technical College has designed a costing system which can be applied to education. The model was first developed to determine initial quality costs for the organization. These initial costs of quality become increasingly more credible as cost center data is calculated in the various departments of the school and displayed in a central costing program.

Establishment of the costing plan begins with the identification of measurement criteria. These are called conforming requirements. Once these have been written, a measurement strategy is determined. Decisions can then be made regarding the cost of factors of achieving the conforming.

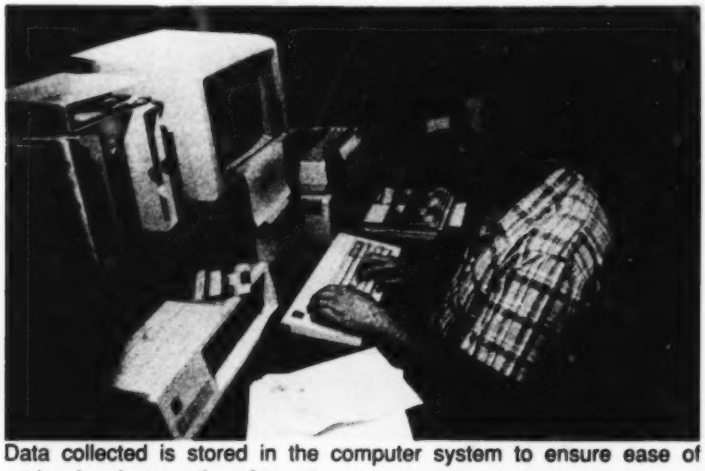
According to the American Society for Quality Control (ASQC), the cost of quality includes the expenditures associated with the prevention of nonconformances and the appraisal of products or services for conformance to stated requirements (or failing to meet requirements).[6]

Calculating and continually monitoring the cost of quality is essential to the process--providing a critical measure of its success.

Two Types of Costs

The Fox Valley Technical College Cost Committee selected two types of costing elements--the cost of conformance elements and the cost of nonconformance elements. The model contains a listing of these

elements together with the criteria used to determine costs under each.



Data collected is stored in the computer system to ensure ease of retrieval and generation of reports.

Calculate Costs of Quality

As stated earlier, there are two types of costs to calculate. These costs of quality include expenses necessary to make or do things right (cost of conformance) and the costs of doing things wrong (cost of nonconformance).

COSTS OF CONFORMANCE

Conformance costs are those expenses related to identifying and preventing errors, and the system revision needed to keep the same errors from reoccurring. Elements included in the Fox Valley Technical College costing model are as follows:

Marketing Research

These are the costs involved in gathering and evaluating data on customers' needs and perceptions about their satisfaction with the school. The criterion used in the Fox Valley Technical College model is 50 percent of the budget of the Research Department. Approximately one-half of the time of the staff in that department is involved in surveying and evaluating data related to the quality process.

Quality Training

The costs for developing and conducting formal training programs to orient employees to quality processes and error prevention are included in this calculation. Fox Valley Technical College uses many different levels of training, and the criterion includes the calculation of all costs associated with

that training with the exception of the time taken by employees to attend training sessions, unless they are paid extra to attend. Since employee time is a major cost, future calculations should include costs for time.

Quality Coordination

The actual costs required for coordinating the quality first process includes the salary of the quality coordinator and the supplies and materials used to document the process. The amount used for determining these costs at Fox Valley Technical College is the entire budget for the quality first process with the exception of those costs which are shown in other categories.

Quality Monitoring and Auditing

While the goal of the quality improvement process is prevention rather than appraisal, it is necessary to maintain a monitoring and auditing system to determine its level of success. Included are the costs for internal financial control systems used in the process. The criterion used is one-half of the Research Department's budget.

Wellness Programs

All wellness programs at Fox Valley Technical College which are used to improve employee productivity and reduce absenteeism are a part of this conformance cost element. These include stress management, nutrition, and exercise programs conducted for employees. The criterion used to determine these costs is the actual expenses for wellness programs.

The costs of conformance calculated for Fox Valley Technical College during the 1987-88 fiscal year are shown in Appendix G. Most of these costs were a part of the regular school budget prior to the initiation of the quality first process. In many cases, staff time and services were transferred from other duties and functions to the quality process.

COSTS OF NONCONFORMANCE

When calculating the costs of nonconformance, it is necessary to determine, as closely as possible, the actual expenses involved when school systems are not operating at 100 percent efficiency. Even though it may be impossible to reach 100 percent efficiency and error-free productivity in all aspects of the school's operation, it is important to calculate the costs of deviating from perfection. Doing this improves employee awareness of the costs of quality and gives school officials a yardstick to determine improvement. Costs of nonconformance calculated for Fox Valley Technical College using data from the last quarter of the 1987-88 fiscal year are shown in Appendix H. The items included are as follows:

It is important to calculate the costs of deviating from perfection.

Resource Utilization/Enrollments

Costs occur when maximum enrollment is not maintained in each instructional program, resulting in excess student stations. The costs are determined by analyzing utilization reports which show the ratio of student occupancy as compared with maximum utilization potential. These costs can be decreased as the department moves toward increasing the student station utilization.

Rework in Service Departments

These costs are based on estimates of rework which is required because of errors or replacement due to incorrect, incomplete, or defective products or services. Quality experts estimate that rework in service departments accounts for between 20 and 40 percent of service department budgets. The criterion used in the Fox Valley Technical College model is 20 percent of each service department's noninstructional budget. The school is working on the design of an actual measurement mechanism.

Retention of Students

These are costs which result from student withdrawals. They are the result of the loss of state aids and tuition. The annual cost at Fox Valley Technical College is approximately $1,900 per year for each withdrawal.

Employee Attendance

These costs occur when employees are absent. Included are salaries for overtime and substitutes. The criterion used at Fox Valley Technical College is based on the loss of time which is above the national average for employee absence--1.8 percent of total time available to work under regular schedules.

Scheduling of Human Resources

Inequitable scheduling of school managers and technical/clerical staff often occurs because of poor planning and inappropriate management. Because of this inefficiency, people are often reassigned to projects which come up at the last minute.

Nonconformance occurs and excess costs result because of this poor planning. The criterion used to determine these costs is five percent of the total labor costs for all management and support staff employees. This criteria is very weak--improvement is being sought through the design of a measurement element.

Customer Service

Individual customer complaints and inquiries about alleged poor service incur costs for staff to investigate, resolve, and respond. Included in these costs of nonconformance are local, state, and federal investigations of alleged affirmative action violations, as well as complaints by students and others. The criteria used to determine these costs is the equivalent of one full-time employee--the time required to handle these complaints and inquiries is the equivalent of one full-time person.

Management of schools, like any other management process, requires accurate measurements which include some of the factors described above and shown in the appendices. Some of these need further refinement and this is occurring. Critics may contend that it is not possible to effectively measure these kinds of costs. Fox Valley Technical College staff believe, however, that careful definition of quality elements in schools, coupled with the establishment of measurable conforming requirements can provide the framework for cost calculations. As the system of measurement and costing matures, the accuracy of cost determination will improve, and cost reductions will become apparent.

The accuracy of cost determination will improve, and cost reductions will become apparent as the system of measurement and costing matures.

The posting of charts within the office area goes a long way toward creating and maintaining an awareness of the process and the impact of daily quality improvement strides.

Set Goals

There are two levels of goals which are used in the quality/measurement process in education. First, there are global goals which are the main targets upon which operational plans are developed. These goals target the conforming requirements of the quality elements. They were explained in a previous section of this book. The second level of measurement is based on problem-solving targets which are established in the various departments or work units. Goals are always limited, to some extent, by the various processes in place at the school. The highest of all goals should always be continued improvement. The quality process provides the vehicle for this to happen.

Each school should have a strategic plan which defines long-range goals and objectives. These goals, together with the mission statement, form the basis for the existence and operation of the school. In the quality first process, the purposes, long-range goals, and quality elements provide the overall direction for the employees. The elements are influenced by the school's goals, mission, and purpose, and they form the organizational targets for the quality improvement process. The 16-step quality process model provides the "how" to facilitate this link. Conforming requirements, which are established for each of the elements, become the basis for measurement and costing which determines whether improvement is occurring in the organization. Using problem-solving and statistical process techniques, the work units of the school establish and measure their unique goals. These are often related to the quality elements.

The highest goal should always be continued improvement. The quality process provides the vehicle for this to happen.

All employees of the school should be familiar with the mission, purpose, and long-range goals of the organization. They should also have opportunities to participate in problem-solving activities in their work units. The various work unit teams select problems which form the basis for specific quality goals which are established and charted. Initially, only a few problems should be identified for measurement, costing, and goal setting. Team members should get together and decide which problems are to be studied using the statistical quality control method.

The emphasis in the work unit goal-setting process should be on the method or process used to meet customers' needs. According to Deming, the establishment of team objectives is composed of four subprocesses:

- identify customer needs
- determine sources of improvement
- identify who can help accomplish improvement
- develop mutual objectives[7]

Summary

Goal setting is an important part of the planning process in schools. Usually these goals are established and reviewed on an annual basis. Problems occur when they are set and measured in isolation from the total operation of the organization.

The quality process alters the school's strategic planning system. It requires that the global goals focus on, among other things, the improvement of quality. Quality elements are derived from the mission and purpose of the school and are first selected by the Quality Improvement Council. Later, as the quality process matures, the elements are reviewed by persons from throughout the school. Sometimes, new elements are added.

In addition to these quality elements, problem-solving goals and objectives are established in the work units. After problems are identified, charting techniques are used and measurement begins. This leads to the establishment of improvement goals. Charting techniques help employees visually identify problem-solving processes, and measurements determine if goals have been met. The use of statistical process control techniques assist educators in the problem-solving process and in the attainment of goals.

Progress made toward a total quality environment will ultimately lead to greater customer satisfaction which will result in tangible benefits for the organization.

The implementation of the quality process will not always lead to direct cost reductions for schools. Progress made toward a total quality environment will ultimately lead to greater customer satisfaction which will result in tangible benefits for the organization. In most cases, it is also possible to identify the costs of

conformance (doing things right) and the costs of nonconformance (doing things wrong).

The analysis of these costs should be shared with all school employees. Since the overall goal is to reduce both the costs of conformance and the costs of nonconformance to the point where funds are available for other necessary services and instruction in the school, all employees should be involved in the problem-solving process. Additionally, they should be able to relate the impact of their problem solving on cost reductions for the school.

Conclusion

Errors, cycle time, withdrawals, assignments, workloads, and other customer data can all be counted, charted, analyzed, and costed with some degree of accuracy. However, data should not be collected just to collect data. It must be valid and useful. Other factors, often external to schools, are more difficult to measure and cost.

At Fox Valley Technical College, for example, one of our products is "transfer of technology." No direct measures of those cost benefits to the student and the employer are included in our model. There are other measures which could be added. Some examples of these are as follows:

- Quality of input through admissions testing
- Quality of output through comparisons with national norms
- Certification scores of nursing graduates compared to state averages of other educational institutions
- Certification of welders and mechanics

These and other internal and external measures and costs will be added to the measurement and costing model as it matures. The significance of this model is that it allows for continued input and modification based on the creativity of the faculty and staff.

There are some basic principles of measuring and costing for use by those involved in this process:

1. Use available data wherever possible; however, continue to select new measures. Take care in the actual selection.

2. Only collect data if it's going to be used in improving processes.

3. Use caution in announcing measurement and costing results. The overzealous manager can create serious problems by publicizing results out of context.

4. Always adjust for inflation when reporting any measurement in terms of currency for comparison purposes. In other words, costs don't have to decrease for productivity improvement to occur.

5. Select measures and cost elements only after determining how each will effectively contribute to the overall purposes and goals.

On page 1, four questions were asked concerning the measuring and costing of quality in education. The staff at Fox Valley Technical College, after almost four years of implementing the quality/productivity process, are convinced that the answers to those questions are a resounding "yes."

- **Yes, it is possible to describe, judge, and improve the effectiveness of schools;**
- **Yes, variances found in the various processes common to education can be correctly and concisely measured;**

- **Yes, quality in education can be looked at in financial terms the way it is in business and industry; and**
- **Yes, statistical techniques and processes are useful for measurement and analysis in education.**

Notes

Quality Element - Human Resources

Each Fox Valley Technical College employee is a valuable resource to the organization. Fox Valley Technical College will work with each employee to enable them to meet the pre-established requirements for their job. Employees will be provided the opportunity to interact with others in such a way that mutual respect for one another and for the organization is achieved.

A quality work environment exists which is supportive of people doing their job right the first time in meeting the educational and service needs of their customers. The organizational climate fosters an attitude of respect for one another and provides opportunities to maximize one's potential. Such an environment is safe, clean, technologically current, comfortable, and attractive for educational and administrative functions.

Fox Valley Technical College employees are expected to display behavior which creates a positive attitude, enthusiasm, loyalty, and a commitment to the goals, objectives, and mission of the institution. Employee commitment, dedication, and hard work will, in turn, enable the College to meet its goals, objectives, and mission.

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
1. Employees meet the minimum qualifications for the position they currently hold. Qualifications for each position must be periodically reviewed and updated as duties and responsibilities change.	Instructional Audits Certification Audits Performance Management Evaluation	$ x 25% certification audit exception Lost labor and productivity Cost of reclassification
2. Professional growth, career planning, and promotional preparedness opportunities are clearly defined. Information and support are made available to employees.	Instructional Audits Professional Growth Budget Performance Management Evaluation Professional Growth Plan	Program discontinuance $150,000 - $200,000 Lower productivity
3. Recruitment activities exist to attract an applicant pool of the most qualified people.	Affirmative Action Plan	Loss of federal monies due to not meeting certain mandated requirements and student financial aid, if found to be discriminatory. Poor public relations. Cost of turnover. Cost of training orientation.
4. Employment practices provide equal opportunities for applicants and promotion of employees.	Affirmative Action Annual Report	Loss of federal monies due to not meeting certain mandated requirements and student financial aid, if found to be discriminatory. Poor public relations.

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
5. Recognition of an employee whose efforts meet and/or exceed the job requirements is immediate, individual, and flexible.	Performance Management Evaluation Climate survey: several questions address this issue Recognition Plan	Attitude problem Decreased productivity Loss of feeling of being part of organization
6. Physical environment reflects the College's mission with emphasis on the adult learner.	North Central Evaluation	Student costs
7. Physical facilities are attractive and are: - professionally designed and maintained - appealing to the needs of the customers - color-coordinated and aesthetically compatible with surroundings.	Organizational Climate Survey Instructional Audit	Employee costs Reduction of FTE's
8. Physical facilities provide handicapped access that is not restrictive and meets all state and local requirements.	North Central Evaluation Instructional audits	Student costs Employer costs
9. Physical facilities are clean and meet state and local health standards.	North Central Evaluation Organizational Climate Survey	Employer costs
10. Physical facilities are adequately furnished with: - proper ventilation - controlled temperature - appropriate level of light lumens - adequate space allocation for each person - adequate design to promote proper sound decibels - adequate rest rooms that are strategically located, sanitized, and maintained	North Central Evaluation Organizational Climate Survey	Employee absence
11. An ongoing annual safety audit is conducted by a College safety committee and immediate attention is given to identify problems.	North Central Evaluation Accident reports Attendance records	Employee absence due to accidents Insurance costs
12. Job activities will be performed at predetermined levels within a specified time period.	Periodic Performance Evaluation Requests for people to pursue professional growth	Loss of productivity Retraining costs Customer dissatisfaction

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
13. Initiative on the job that includes suggesting new ideas to improve personal and/or FVTC performance and job satisfaction.	The number of ideas/suggestions that employees make via evaluation or suggestion box. We need to encourage this creativity to happen.	
14. Flexibility which includes the ability and willingness to readily accept and adapt to changes in procedures or assignments.	Climate Survey Student Evaluation of Instruction	
15. A positive attitude and enthusiasm on the job, including cooperation with all other employees, customers, and the general public, and working toward the implementation of goals and policies with an openness to constructive criticism.	Organizational Climate Survey; this will give an indication, but will not measure directly. Could test new hires via Testing Center. Student Evaluation of Instruction	Decrease in productivity Absenteeism Tardiness
16. The ability to effectively communicate--listen, understand, speak, and be understood both in written and oral communication.	Evidence of teamwork communication in climate for work group area.	
17. The development and demonstrated progress toward fulfillment of a personalized professional growth plan.	Existence of a Professional Growth Plan Work in progress toward fulfillment of plan Certification Requirements	
18. Manager needs to actively promote teamwork and problem-solving within their immediate unit and beyond in order to develop higher levels of job satisfaction and esprit de corps.	Organizational Climate Survey Performance Evaluation	Higher reported numbers

Quality Element - Curriculum and Instruction

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
1. Curriculum is based on competencies needed for the person to perform successfully on the job.	Instructional Audit Employer Survey North Central Evaluation	Student and Employer Costs
2. There is a complete plan for learning for each course in a program and the computer is used as a tool to maintain a master file in a central location. (See policy - Curriculum Documentation)	Instructional Audit North Central Evaluation	Student Costs Rework when revising curriculum
3. Each program has a written list of course prerequisites.	Program Development State Regulations Program Revision State Regulations North Central Evaluation	Student Costs Loss of FTE's
4. Examinations have criterion with a direct link to the performance objectives.	Instructional Audit	Employer Costs
5. Students are aware of expectations for each course. This includes a syllabus, grading policy, attendance, and safety requirements.	*No measurement in place at this time. Will be a unit objective for next year	Student Costs
6. Students may receive advanced standing and/or credit for past experiences in education or in occupations related to the program.	Instructional Audit Student Satisfaction Survey *Counselor Survey (formal mechanism not in place)	Student Costs
7. Programs are structured to permit multiple-entry and multiple-exit.	Instructional Audit Utilization Reports North Central Evaluation	Student Station Occupancy Ratios
8. The program's advisory committee is active and meets at least twice each year.	Instructional Audit North Central Evaluation Minutes sent to Vice President	Retraining Costs based on Guarantee

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
9. Each program will provide some type of work experience related to the students' training.	Instructional Audit North Central Evaluation	Student and employer costs
10. There is a plan in each Division to evaluate instruction and instructors. (See Human Resources Conforming Requirements)	Instructional Audit *(Needs additional measurement activities)	Student costs Taxpayer costs
11. An optimum class size is established for each course.	Instructional Audit Student Satisfaction Survey	Student costs
12. There are formal articulation and/or transfer credit agreements with area secondary and postsecondary schools for each program.	Instructional Audit North Central Evaluation	Student costs Taxpayer costs
13. Instructors use a variety of teaching techniques to meet the unique needs of the learner.	Instructional Audit Student Satisfaction Survey	Student costs
14. Instructors conform to established timelines. a) Classes start and stop on time. b) Grades are submitted promptly.	Student Satisfaction Survey	Student costs
15. Curriculum and course requirements are consistent for content, textbook, and grading. Exceptions must be approved by the Dean.	Student Satisfaction Survey	Student costs
16. Faculty assess students' needs, determine strengths and weaknesses, prescribe learning paths for students, and make appropriate referrals to improve the retention of students.	Instructional Audit Student Withdrawal Report	Student costs Loss of FTE's
17. Curriculum and instruction is customized for individual businesses to assist them with their productivity and profitability.	Requirements of Customer Contract	Employer costs Retraining costs
18. Instructors utilize industry standard technology placing emphasis on leading edge technology as identified by advisory committee.	Instructional Audit Employers Survey Placement Records	Student and employer costs

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
19. All courses in full time programs have some high-technology components which require students to use computers regularly.	Instructional Audit Employer Survey	Student and Employer Costs
20. Services to support student success are accessible and effective.	Student Satisfaction Survey	Student Costs Loss of FTE's

*Needs development of measurement strategy.

Quality Element - Planning

Fox Valley Technical College utilizes a strategic planning process which encourages and provides opportunities for participation at all levels in the organization to include both short and long-range plans that are consistent with the directions of the institution. Planning is used as the cornerstone for establishing goals, operational plans, and individual management objectives with research being used to solidify that framework. An important factor is the necessity to link the strategic planning process with the operational and budgetary process. The purpose of this linkage is to properly reflect resource allocation.

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
1. The College's current mission and purpose is clearly stated without ambiguous or confusing jargon.	FVTC Board Approval Documentation of Review Plan	District resources may be used on inappropriate activities.
2. There is a written organizational plan which contains strategic directions that are updated annually.	Approval of Executive Cabinet Documentation of Review Plan	Resources may be allocated improperly resulting in unmet goals and unwise use of fiscal resources.
3. The needs of external customers are identified, and the data collected is prioritized and utilized to provide direction for the organization.	Advisory Committee Minutes Instructional Audits Program Approval Employer Survey	High cost, low enrollment programs, and customer complaints where customer needs are not being met. Employer costs. Loss of community support.
4. The strategic directions of the organization are evaluated in setting our future directions.	Instructional Audits Student Satisfaction Survey	Loss of student and taxpayer support due to unmet needs.
5. Individuals at all levels in the organization are involved in the planning process and surveyed to identify their perspective on needs/priorities.	Climate Survey Employee Satisfaction Survey	Poor staff morale, lack of support and commitment to the organization. Increased grievances and labor unrest.
6. The operational is the basis for development of the budget.	Annual Budget Instructional Audits	Goals and objectives in operational plan not met, poor employee morale, lack of customer satisfaction.

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
7. Communication on operational planning is on-going and flows upward, downward, and across the organization.	Climate Survey Instructional Audits North Central Evaluation Advisory Committee Minutes	Poor coordination of activities result in higher FTE costs and poor customer service.
8. The planning process needs to be continuous (year round) and flexible to allow the organization to be dynamic and responsive.	Budget Allocations Staff Satisfaction Instructional Audits North Central Evaluation	Inability to change priorities as needs change will result in higher student drop-out rates, poor employee morale, and higher employee turnover.

Quality Element - Use of Technology

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
1. Management units utilize technology and support services to effectively manage and produce concise reports, documents, communications, and schedules.	Survey staff to find out if they: Are receiving the reports they need to manage effectively Are getting the reports in a timely manner Are using the reports to guide their action Review conciseness of internally generated reports and communications Insist on short memos (no more than one page)	Paper costs Employee costs of meetings where lengthy reports are presented Costs of handling, reading, storing, etc. excessively long documents
2. Through the use of electronic data generation and on-line view capabilities, hard copy documentation is significantly reduced.	Measure volume of paper used (should show minimum of 10% decrease during first full year) Survey staff to determine: Extent of electronic system use Possible improvements	Paper cost Costs of handling and storing hard copy documents
3. All service and support units utilize technology to manage their processes effectively and productively.	Determine processes to be automated Measure progress being made toward automation	Employee costs of continuing to do things manually Cost of lost increases in productivity
4. Instructional managers utilize media and information processing systems to effectively support faculty with the instructional process.	Determine processes to be automated Measure progress being made toward automation Climate Survey	Lost employee productivity
5. Technology is used to effectively assist in the teaching and management of instructional programs offered under the perpetual enrollment/graduation process.	Instructional Audit Student Station Occupancy Withdrawal Reports Graduate Follow-up Student Evaluation of Instruction	Lost FTE's Cost of idle student work stations Cost of student non-completion Cost of poor institutional image

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
6. Instructional management employs central computerized record-keeping systems to monitor student progress and performance.	Instructional Audit Survey of Students Survey of Staff	Student Costs Cost of poor institutional image
7. Instructors utilize industry standard technology placing emphasis on leading-edge technology as identified by advisory committees.	Instructional Audit Employers Survey Graduate Follow-up Advisory Committees	Employer costs of additional training Student costs of lost opportunity Cost of lost Economic Development contracts Cost of lost FTE's Cost of retraining Cost of poor institutional image
8. All courses in full-time programs have some high technology components which require students to use computer technology.	Instructional Audit Student Evaluation of Instruction Advisory Committee's review	Employer costs of additional training Student costs of lost opportunity Cost of lost Economic Development contracts Cost of lost FTE's Cost of retraining Cost of poor institutional image
9. Courses use technology to assist faculty with computer-based testing, drill and practice tutorial education, and other computer-based education components.	Instructional Audit Student Satisfaction Survey Student time on computer reports Advisory Committee's review Curriculum Design review	Employer costs of additional training Student costs of lost opportunity Cost of lost Economic Development contracts Cost of lost FTE's Cost of retraining Cost of poor institutional image

Quality Element - Marketing

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
1. A current, flexible tactical marketing plan is in place and is implemented throughout the College. This plan includes strategies to reach the following markets:		
a. High school market	Percentage of high school graduates who enroll at FVTC based on targets	Failure to meet enrollment targets results in loss of state aids and tuition
b. 19-24 year old market	Comparing unduplicated headcount from previous year based on targets	Student loss x average credit load x Tuition costs x state aids
c. 25-54 part-time market	Comparing unduplicated headcount from previous year based on targets	Student loss x average credit load x Tuition costs x state aids
d. Business and industry training market	Number of B & I contracts and dollars generated compared with previous year	Loss in dollars generated by contracts
e. Avocational and life-long learning market	Number of avocational course enrollment figures as compared to previous year	Loss of tuition cost
2. The perception of general district citizens toward FVTC is favorable.	Yearly Perception Research Study conducted by Research Department North Central Evaluation	Long term FVTC marketing costs would increase
3. Customers are satisfied with FVTC products and services.	Annual Employer Satisfaction Survey Annual Student Satisfaction Survey Guaranteed Student Satisfaction for B & I	Long term FVTC marketing costs would increase Cost of retraining
4. There is a written Marketing Plan for each instructional and administrative unit that is current and in support of the District Plan.	Instructional Audit North Central Evaluation Yearly Comprehensive District Marketing Tactical Plan.	Long term FVTC marketing costs would increase. Staff layoffs Program discontinuance Increased cost per FTE

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
5. Reliable and valid research is incorporated into the marketing process to ensure continued improvement.	Measurement of tactical marketing promotional strategies and reports on results published. Documents include: a. Evening Tabloid b. B & I Seminar Catalog c. Advertising-Institutional d. Catalog f. Advertising-specific program	Does not have measurement tied to it

Quality Element - Customer Service

Conforming Requirements	Measurement Strategy	Cost of Nonconformance
1. All customers* are greeted and served in a friendly and cordial manner.	Customer Satisfaction Surveys	Customer Service - Costs are incurred to investigate, resolve, and respond to individual customer complaints or inquiries. Included are costs for local, state, and federal investigations of alleged affirmative action violations. Criterion used = Actual time spent handling complaints - initially estimated at one full-time equivalent employee. Retention of Students - These are student attrition costs. While the loss of students creates utilization costs these are additional costs because of the loss of state aids and tuition. Criterion used = Loss of 530 full-time equivalent students FTE's (1126) Dropouts x state aids/tuition loss)
2. All customers have opportunities to evaluate the instruction and services from the customer's perspective.	Customer Satisfaction Surveys	
3. All FVTC faculty and staff are continuously inserviced in all aspects of customer service from the customer's perspective.	Inservice program agendas	
4. All customer complaints and concerns are handled quickly and efficiently.	File of grievances, ECR forms, CA reports, customer complaints	
5. All faculty and staff know and are trained on the scope of services available at FVTC.	Orientation program agendas Inservice program agenda	
6. There are internal and external customers. Every courtesy and support is given to internal customers, they in turn can give the best quality service to external customers.	Customer Satisfaction Surveys	
7. A method or methods to gather customer response is/are developed and used to measure and improve customer service and satisfaction at FVTC.	Satisfaction Surveys Organizational Climate Surveys	
8. Customer Service Committee develops and reviews customer satisfaction reports. The Committee suggests training programs and makes recommendations to the QIC to improve internal and external customer services.	Committee Minutes Customer Satisfaction Surveys	
9. Each service department of the school develops conforming requirements specific to the customers they serve.	List of Conforming Requirements in each department Customer Satisfaction Surveys	

* Includes students, staff, community visitors, employers, vendors, etc.

Quality Element - FVTC 1987-88 Costs of Conformance

	Cost of Conformance	Itemized Costs	
1.10	**Marketing Research**		$ 26,554
	(Based upon 50 percent of Research Department budget)		
	1.11 Labor	$ 22,030	
	1.12 Printing	1,032	
	1.13 Mailing and supplies	3,492	
1.20	**Quality Orientation and Training**		68,805
	(Based upon actual costs except staff time)		
	1.21 Labor (Instructor)	27,951	
	1.22 Instructional materials	20,410	
	1.23 Workshops and conferences	20,444	
1.30	**Quality First Process Coordination**		43,707
	(Based upon actual costs)		
	1.31 Labor (coordination)	27,259	
	1.32 Supplies and materials	1,425	
	1.33 Research design costs	15,023	
1.40	**Quality Monitoring and Auditing**		26,554
	(Based upon 50 percent of Research Department budget)		
	1.41 Labor	22,030	
	1.42 Printing	1,032	
	1.43 Mailing and supplies	3,492	
1.50	**Wellness Program**		6,439
	(Based upon costs of operation)		
	1.51 Labor	5,905	
	1.52 Supplies and materials	534	
	TOTAL COST OF CONFORMANCE		**$172,059**

Quality Element - FVTC 1987-88 Costs of Nonconformance

2.10	**Resource Utilization/Enrollments**					
	(Based upon percentage of maximum enrollments)					
	2.11	Direct instruction				$3,497,336
						1,850,032
			Enrollment	Capacity	Direct Cost	
		Business enrollment	713	895	2,354,753	478,844
		General Education enrollment	870	1,070	3,294,182	615,735
		Health and Human Services enrollment	790	887	2,689,274	294,092
		Technical enrollment	1,060	1,181	3,330,313	341,209
		Oshkosh enrollment	301	348	605,494	81,776
		Economic Development enrollment	89	106	239,283	38,376
			3,823	4,487	12,513,299	1,850,032
		Division Overhead				257,190
	2.12					
				Division Cost	Division Idle Capacity	
		Business enrollment		401,161	20.34%	81,577
		General Education enrollment		173,286	18.69%	32,390
		Health and Human Services enrollment		692,890	10.94%	75,773
		Technical enrollment		472,216	10.25%	48,381
		Oshkosh enrollment		85,134	13.51%	11,498
		Economic Development enrollment		47,213	16.04%	7,572
				1,871,900		
	2.13	Institutional Overhead			75.14%	1,390,114
2.20	**Rework in Service Departments**					1,138,365
	(Based upon 20% of service department budgets or actual)					
	2.21	Labor to correct			961,101	
	2.22	Machine time			135,478	
	2.23	Supplies			41,786	
					1,138,365	

2.30	**Retention of Students**				2,156,000
	(Based on FTE loss times state aids/tuition)				
			F.T.E.'s		
		Business dropouts	220.00		
		General Education dropouts	264.00		
		Health and Human Services dropouts	218.00		
		Technical dropouts	286.00		
		Oshkosh dropouts	88.00		
		Economic Development dropouts	2.00		
			1,078.00		
	2.31	Loss of state aids		900.00	970,200
	2.32	Loss of tuition		1,100.00	1,185,800
2.40	**Employee Attendance**				382,115
	(Based upon loss of time above 1.8% of total time available)				
	2.41	Overtime due to absence	18,497,537	1.80%	332,956
	2.42	Substitutes	49,159		49,159
2.50	**Scheduling of Human Resources**				924,877
	(Based upon 5% of labor costs)				
	2.51	Actual labor	18,497,537	5.00%	924,877
2.60	**Customer Service**				25,578
	(Based upon actual time handling complaints - initial estimate one employee)				
	2.61	Reports and correspondence	25,578		25,578

TOTAL COST OF NONCONFORMANCE **$8,124,270**

Endnotes

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6. Principles of Quality Costs, American Society for Quality Control Quality Costs Committee, Campanella, Jack (Chairman), Hagan, John T. (Editor), American Society for Quality Control, Milwaukee, Wisconsin.

7. Scherkenbach, William W., The Deming Route to Quality and Productivity, Mercury Press, Rockville, Maryland, 1986, pp. 58-61.

The Academy for Quality in Education

The Academy for Quality in Education has been established to provide assistance to educators who want to learn about and implement the quality improvement process. The Academy uses the quality model designed by Fox Valley Technical College as its recommended plan for implementation by other schools. The College staff members serve as faculty in The Academy, and FVTC is a living laboratory for schools to review.

Information concerning membership in The Academy and the services and products which are available may be obtained by contacting:

The Academy for Quality In Education
5 Systems Lane
P.O. Box 2277
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Telephone 414-735-5707
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- Can we describe, judge and improve the effectiveness of schools?
- Can we correctly and concisely measure the variances found in the processes common to education?
- Can quality in education be looked at in financial terms the way it is in business and industry?
- Are statistical techniques and processes useful for measurement in education?

Find answers to these and other important questions in this dollars and "sense" look at education.